

Summary of report on LEED™ Credit Evaluation Project September 2002

Original Objectives for LEED™ Credit Evaluation Project

This project focuses on the application of the Life-Cycle-Assessment (LCA) methods to enhance metrics and tools for assessing buildings' environmental impacts. These objectives will be accomplished by using the previously completed life cycle inventory of a classroom/office building on the University of Michigan campus (Sam Wyly Hall) to explore the environmental implications of LEED credit points.

Project Objectives

- 1) Utilize LCA methods to determine environmental impacts¹ of the LEED credits, and critique LEED's point distribution within the following credit sections:
 - a) Material credits
 - b) Energy credits
- 2) Propose modifications of LEED

Realization of Project Objectives

- 1) **LCA methods were successfully utilized to explore the impacts of the following 6 LEED Credits**
 - a) Material credits
 - i) Construction Waste Management
 - ii) Recycled Materials
 - iii) Local / Regional Materials
 - b) Energy credits
 - i) Optimize Energy Performance
 - ii) Renewable Power
 - iii) Green Power
- 2) **Recommended modifications of LEED result from the wide range of disparities among the measured impacts. Modifications focus on 4 critical areas of the LEED program which affected outcomes.**
 - i) Calculation Methods: The LEED credit calculations themselves often create disparate outcomes that appear to undermine the individual credit intention.
 - ii) Threshold Appropriateness –The thresholds established for measuring credit achievement were often found to be unrelated to the measured environmental impacts.
 - iii) Comparability: Comparable outcomes in LEED did not have comparable impacts (for energy and solid waste generation).
 - iv) Distinctions in Applied Solutions: LEED credit mechanisms often do not account for variables of the specific conditions that are invoked by individual credits

¹ energy & resource consumption, GWP, AP, NP, waste generation, human toxicity

Research Methods Utilized and Summary of Outcomes

- 1) Assess environmental impacts of base case building (Sam Wyly Hall)**
 - a) Environmental impacts of base case building are detailed in the Sam Wyly Hall (SWH) LCA².
 - b) Refinements are made to the operations phase model of SWH, resulting in an increased projection for operations phase energy consumption. This result appears more in line with University of Michigan data.
 - c) SWH is projected to consume 2,300,000 GJ of primary energy over a 75-year life span and produce 8,600 tonnes of solid waste. 97% of the energy and 32% of the waste are produced during the operations phase.
- 2) Run alternative scenarios, according to various LEED credit requirements**
 - a) 6 individual credits are simulated based on achieving LEED credits through a variety of methods. In each simulation several scenarios with different environmental outcomes, but similar LEED credit scores are compared. Each credit is detailed in the following format.
 - i) Credit Intention
 - ii) Credit Structure
 - iii) Credit Calculation Discussion
 - iv) Simulation: Key Parameters
 - v) Simulation: Methods
 - vi) Simulation: Results
 - vii) Analysis
 - viii) Recommendations
- 3) Compare point distribution in LEED to LCA-based distribution of environmental impacts**
 - a) Energy and solid waste outcomes from the individual credit simulations are analyzed, and an intracredit comparison is conducted.
 - b) Overall the LEED point distribution does not relate well to the LCA based distribution of environmental impacts.
- 4) Compare environmental impacts between different credit sections (*Energy and Atmosphere* versus *Materials and Resources*)**
 - a) While the *Materials and Resources* credits are intended to address solid waste generation among other impacts, the *Energy and Atmosphere* credits as a group actually offer greater solid waste reductions per LEED point.
 - b) The *Energy and Atmosphere* credits offer substantially greater energy savings per LEED point than the *Materials and Resources* credits.
 - c) This report was limited to an assessment of energy consumption and solid waste generation, and could not address impacts, such as resource depletion, which are a significant element of LEED.
- 5) Develop recommendations for improving the LEED rating system credits**
 - a) Many recommendations are detailed throughout this report. Recommendations include,
 - i) Improvements to LEED metrics and standards used.
 - ii) Specific credits that should be evaluated in terms of their potential benefits.
 - iii) Suggested avenues of research needed to develop LEED standards.

² Reppe, P., C. Scheuer, and G.A. Keoleian, *Life Cycle Energy and Environmental Performance of a New University Building*. Energy and Buildings, 2002. **under review**.